Overview of the MARAMA $PM_{2.5}$ Forecasting Project

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Presentation Outline

- A Brief Overview of MARAMA
- The Need for $PM_{2.5}$ Forecasting Support
- The MARAMA $PM_{2.5}$ Forecasting Project
- A Look at the Future

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The Mid-Atlantic Regional Air Management Association (MARAMA)

- MARAMA
  - non-profit association of 10 state and local air pollution control agencies
  - organized in 1990 by Mid-Atlantic Governors, Mayors, and County Commissioners
  - promotes cooperation and coordination among state and local air quality agencies
  - Members include: DE, DC, MD, NJ, NC, PA, VA, WV, Philadelphia, and Allegheny County, PA

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MARAMA's Mission

- MARAMA's mission is to strengthen the skills and capabilities of member agencies and help agencies work together to prevent and reduce air pollution in the Mid-Atlantic region.

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The Need for $PM_{2.5}$ Forecasting Support

- Many members have strong ozone forecasting programs, but little or no experience forecasting PM
- There is increasing interest in fine particulate pollution because of its adverse human health impacts.
- MARAMA states are observing relatively high PM 2.5 values in some areas

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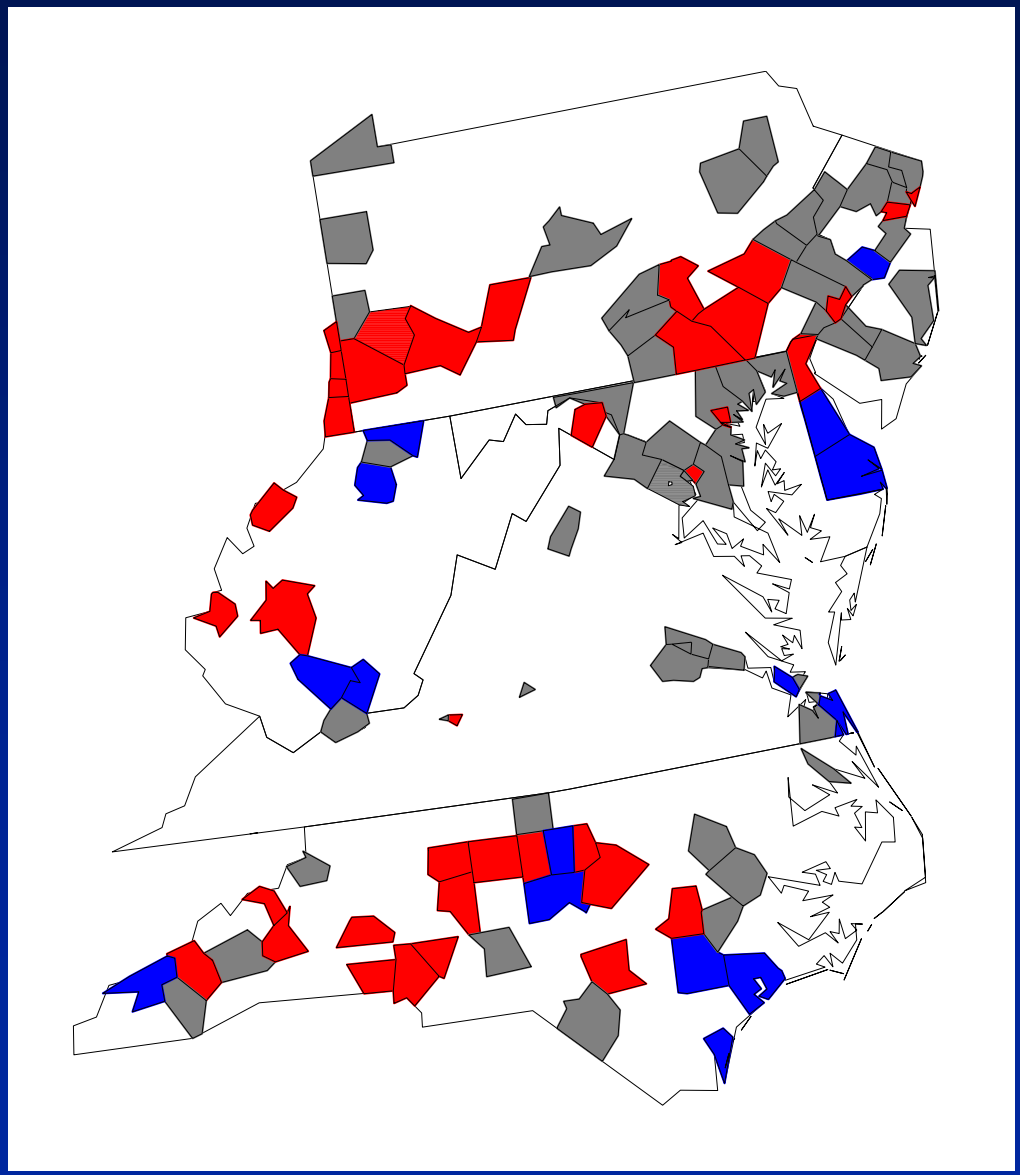
1999-2001 Annual PM 2.5 Design Values in MARAMA Region



Data from EPA's AQS 7/8/02

Counties with at least 1 complete site with design value >15.0

Counties with at least 1 complete site with design value ≤15.0

Counties without a complete site

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The Need for $PM_{2.5}$ Forecasting Support

- MARAMA members are concerned about the resources needed to do year-round air quality forecasts
- Human Resources:
  - In some state/local agencies, there may not be adequate staff to forecast ozone seasonally and PM year-round
  - Adequate coverage on weekends and holidays will require more than one meteorologist
- Some areas are concerned about needing more continuous monitoring data

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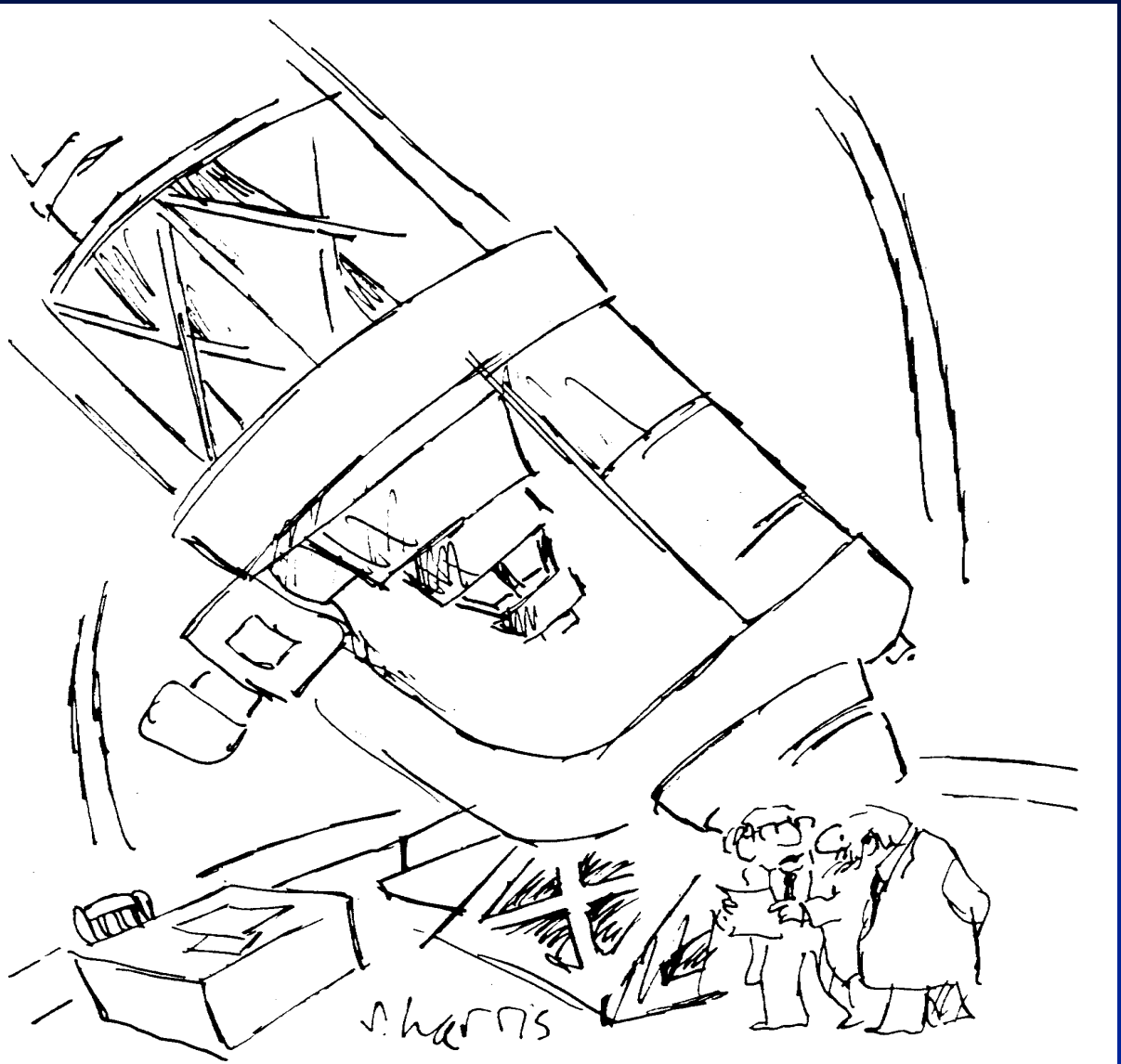

"THE ONLY PART OF THE UNIVERSE WHICH ISN'T EXPANDING IS THE BUDGET FOR THIS PLACE."

The MARAMA $PM_{2.5}$ Forecasting Project

- The purpose of the project is to:
  - analyze PM data and trends,
  - develop and improve $PM_{2.5}$ forecasting methods and tools, and
  - train and support PM forecasting teams

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The MARAMA $PM_{2.5}$ Forecasting Project

- MARAMA plans to hire a contractor to:
  - develop Classification and Regression Tree (CART) tools for nine cities
  - work closely with state and local forecasters to apply, test and evaluate the tools
  - conduct a workshop to train forecasters

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The Forecast Cities

- CART tools will be developed for:
  - Baltimore, MD
  - Bristol, Richmond and Roanoke, VA
  - Charlotte, NC
  - Newark/Elizabeth, NJ
  - Philadelphia, PA
  - Washington, DC
  - Wilmington, DE

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The Project Schedule

Task	Completion Date
Collect and analyze monitoring and met data	June 2003
Develop CART tools	August 2003
Conduct workshop	October 2003
Evaluate CART performance	October-January 2004
Final report	February 2004

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The Selection of the CART Method

- Why CART was chosen for the forecast project:
  - CART can be used to identify the different meteorological conditions that lead to different PM levels
  - provides a rigorous and objective means for distinguishing among different types of PM episodes
  - forecasters in the MARAMA region wanted experience with this tool

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What is CART?

- CART is a statistical tool used to separate historical data into classification “bins”
  - bins are associated with a range of values of a classification variable (e.g., $PM_{2.5}$ concentration)
  - classification in a bin is based on the value of other parameters (e.g., observed meteorological data, regional PM concentration, etc.)
  - CART software identifies the parameters with the highest correlation to observed PM concentration

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What is CART?

- CART software uses these parameters to split the dataset into two dissimilar groups or bins
- This is process is repeated until the resulting bins contain days with similar PM concentrations
- In this manner, CART identifies the meteorological conditions (the splits) that are associated with PM concentrations and episode types (the bins)

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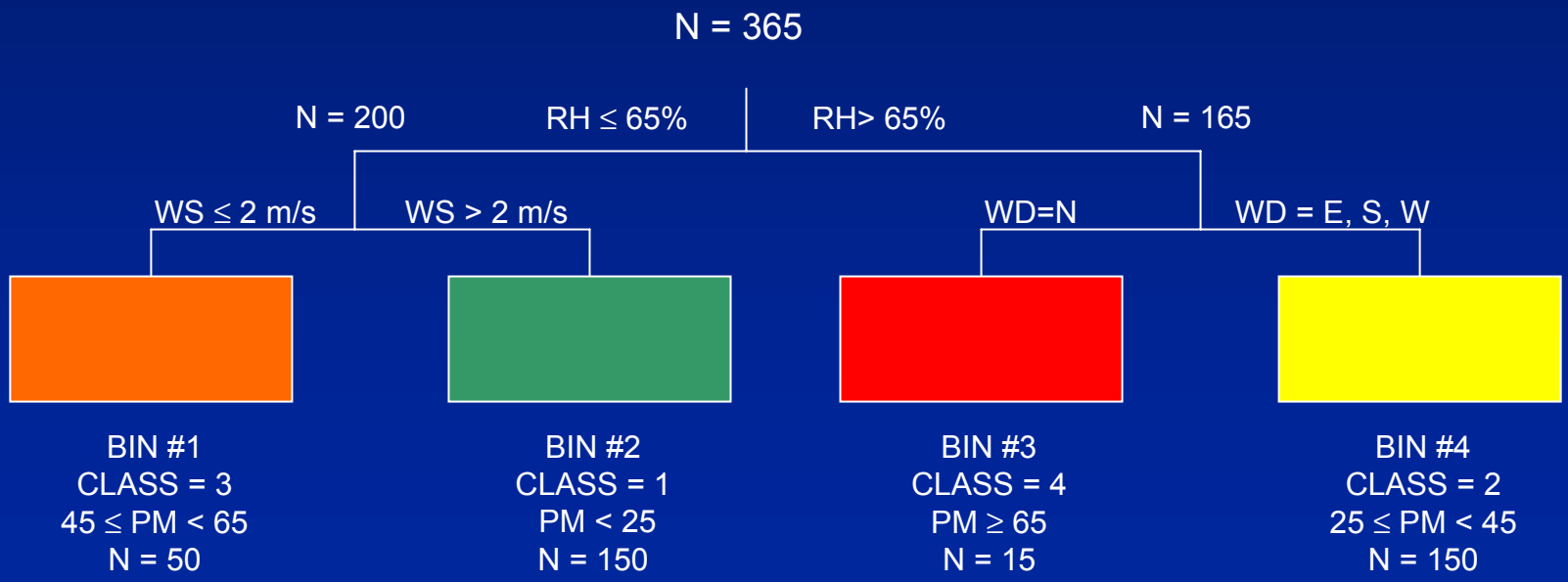
An Example of a CART Tree

- CART output takes the form of an up-side-down classification “tree”
- Branches/splits (of the data) determine the binning



The MARAMA $PM_{2.5}$ Forecasting Project

- After the CART tool has been developed, the contractor will:
  - conduct a training workshop for MARAMA forecasters next fall
  - work with forecasters for four months to evaluate and enhance the CART tool
- The CART tool will serve as another tool in the forecasters "tool kit" for forecasting PM levels
- MARAMA and MARAMA members will "own" the tool, its data and logic so that state staff can modify and improve forecast performance

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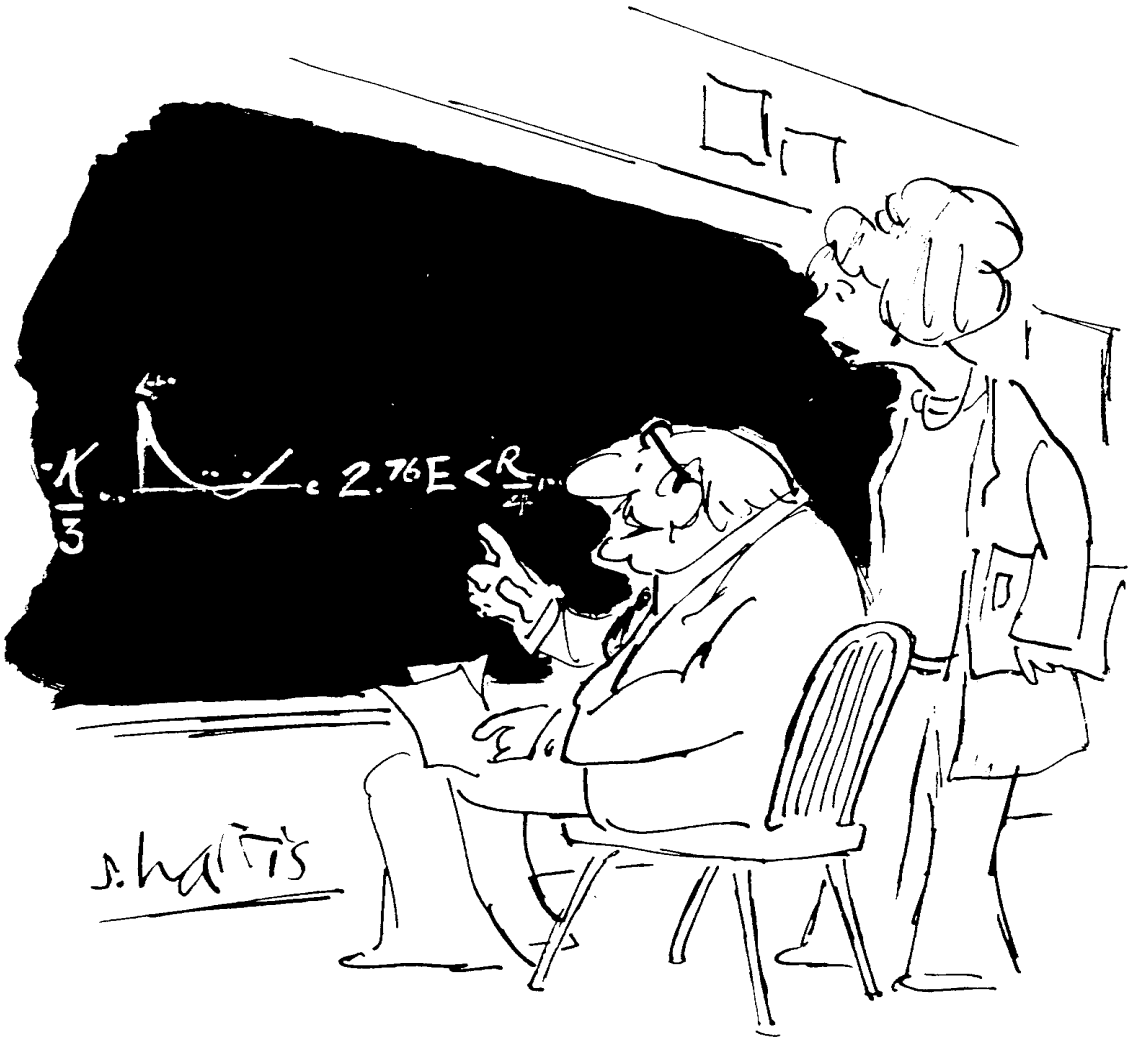

"THE BEAUTY OF THIS IS THAT IT IS ONLY OF THEORETICAL IMPORTANCE, AND THERE IS NO WAY IT CAN BE OF ANY PRACTICAL USE WHATSOEVER."

A Look at the Future

- Some challenges lie ahead...
  - we do not have a long historical record of continuous data on which to base our PM forecasts and forecast tools
  - getting the forecast right may be difficult for some areas and conditions – our credibility is on the line
  - many forecasters in the MARAMA region would like about a year to test and evaluate forecast tools before going public with PM forecasts

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A Look at the Future

- But with the challenges come opportunities...
  - we will learn a lot more about air pollution and the atmosphere
  - rather than focusing on one pollutant, we will have to take a more holistic view, make a more comprehensive analysis
  - new information will improve emission inventories, air quality models, forecasting tools, etc.
- We appreciate the opportunity to help improve air quality forecasting in the MARAMA region

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Notes and Credits

- The MARAMA web site address:

  http://www.marama.org

- Credits:
  - Cartoons from: Einstein Simplified, Cartoons on Science by Sidney Harris, Rutgers University Press
  - CART Tree from Sharon Douglas, ICF/SAI

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